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ABSTRACT

Forty infants, 10 at 4, 6, 8, and 10 months, were confronted by an experimenter who acted out angry, happy, sad, and neutral facial experssions, accompanied with appropriate vocalizations. The infants' responses were recorded on video tape and rated for attention, negative and positive affect, and activity. Results indicate that the 4-month old infants responded indiscriminately to the various expressions, but the 6-month and older infants discriminated between the emotions with attention and negative affect behavior and in many cases responded with the appropriate emotion. These results confirm, in part, earlier observations made by Darwin (1877) and Buhler & Hetzer (1928). The distinctive features of the experimenter's behavior which elicited the appropriate reactions from the infants were not determined. (Author)

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INFANTS' REACTIONS TO DIFFERENT EXPRESSIONS OF EMOTIONS

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Introduction

Although there is consensus about the importance of non-verbal communication in general (v. Birdwhistell, 1970; Eibl-Eibesfeldt, 1970), and especially in the social interactions of the pre-verbal child (Darwin, 1872; Bowlby, 1969; Rheingold, 1969; Blurton-Jones, 1972), there is relatively little research which demonstrates the pre-verbal child's sensitivity to non-verbal signals. As Kessen, Haith, and Salapatek (1970) point out, there are two aspects to the study of early social development: the development of the young infant's ability to change the behavior of others and the development of his responsiveness to others. This paradigm of mutual regulation has not significantly guided research in early non-verbal communication.

In most areas of infant research the behavior of the infant has received much more emphasis than his responsiveness to various social signals. There is considerable documentation of the infant's crying, smiling, and babbling--all of which play an important role in influencing the behaviors of others (v. Charlesworth & Kreutzer, 1973). In contrast only a relatively small portion of the research literature deals with the infant's sensitivity to social stimuli. Although a good part of this research has focused on the infant's reaction to schematized faces (e.g., Fantz, 1966; Koopman & Ames, 1968), very little is known about the natural expressive features of the face and their social-emotional significance for the infant. The relevant literature will be reviewed here since it provides the basis for the present study.

Summary

Forty infants, 10 at 4, 6, 8, and 10 months, were confronted by an experimenter who acted out angry, happy, sad, and neutral facial expressions, accompanied with appropriate vocalizations. The infants' responses were recorded on video tape and rated for attention, negative and positive affect, and activity. Results indicate that the 4-month old infants responded indiscriminately to the various expressions, but the 6-month and older infants discriminated between the emotions with attention and negative affect behavior and in many cases responded with the appropriate emotion. These results confirm, in part, earlier observations made by Darwin (1877) and Bühler & Hetzer (1928). The distinctive features of the experimenter's behavior which elicited the appropriate reactions from the infants were not determined.

Infants' reactions to adults' expressions of emotions

One of the first reports on infant sensitivity to emotions in others was Darwin's observations of his own son which suggest some sensitivity to the emotional expressions of adults in the first half year of life. In a paper which appeared in Mind (1877), Darwin spoke of the infant's ability to understand expressive behavior as social signals or as expressions of emotions, commenting that "an infant understands to a certain extent, and as I believe at a very early period, the meaning or feelings of those who tend him, by the expression of their features" (p. 293). Darwin cites as an example his 5-month old son's reaction to his nurse's feigned tears; his son reacted by assuming a melancholy visage, with the corners of his mouth well-depressed. This reaction was interpreted by Darwin as indicating that the infant was capable of recognizing the plight of the nurse and also of responding in an appropriate way.

Bühler and Hetzer (1928) compared infants' reactions to a positive face (smiling) and a negative face (an angry face with lips pressed tightly together, the corners of the mouth pulled down, the brow knitted); they also compared infants' reactions to positive and negative voices, and to threatening and affectionate arm gestures, acted silently with a neutral face. Each of these 6 stimuli was presented for 30 seconds to 90 infants, 10 at each age level from 3-11 months. Judges rated the infants' reactions as positive (involving a composite of responses including smiling and moving the arms joyfully) or negative (involving a composite of responses including motionless limbs and crying). Results indicate that by the fifth month, infants are capable of discriminating between angry and happy facial

expressions and acting appropriately: from 5-7 months, 100% of the infants responses to the angry face were negative. In slightly older infants, neutral reactions accounted for up to 40% of the total responses; whereas the frequencies of positive and negative reactions did not differ significantly. Results for the negative versus the positive voice paralleled those for the facial expressions. The discriminations of the threatening versus the affectionate motor gestures appeared slightly later than discriminations of the positive versus negative facial expressions and voices.

Bühler and Hetzer interpreted these results as indicating that between the fifth and eighth month, infants are not only capable of differentiating between the two facial expressions, voices and gestures, but also responding appropriately. From 8-12 months, however, these discriminations are no longer apparent. The infant at this age, after initial hesitation, frequently laughs and shows other positive behaviors, treating the mock scolding as a joke or a game.

The results of this study along with a related study by Hetzer & Tudor-Hart (1927) were subsequently incorporated by Bühler (1930) into an infant scale of development. This scale was standardized with 40 infants at each of 10 age levels. Bühler considered the ability to differentiate a smiling face accompanied by a friendly voice from a scowling voice accompanied by a scolding voice as evidence of normal fifth month development. The criterion for a 'pass' on this item was "smiling and positive expressional movements in answer to the friendly attitude, negative expressional movements in answer to the angry attitude." According to Bühler, this test item was designed to determine whether the child was

capable of making basic social differentiations; or whether the child was still reacting unselectively to all social stimuli. The ability to distinguish between friendly and angry voices was considered as evidence of normal sixth month development. Bühler felt that the child's ability to make this discrimination reflected a basic level of social understanding since "the child, not seeing the adult, cannot reflect her expressions nor can he be reacting to the sensory stimulus of the change in tone of the voice itself, as this is strictly avoided by the experimenter." (p. 223) As a seventh month item, Bühler included the ability to differentiate between angry and friendly facial expressions. Since the infant was given credit for this item only when his positive and negative reactions did not duplicate the experimenter's expressions, Bühler's work provides reasonable evidence that imitation cannot account for all sensitivity to adults' facial expressions of emotions shown by infants. The ability to differentiate between threatening gestures (the experimenter shakes her finger threateningly at the infant) and positive gestures (E stretches out her hands welcomingly and uses movements to invite the infant to her) was considered by Bühler as evidence of normal ninth month development. Once again, in order to receive credit for this item, the child could not merely imitate the experimenter's gestures. Rather, the child was expected to show positive or negative expressive behaviors, in addition to approach or withdrawal.

In contrast to the work of Bühler and Hetzer, Spitz & Wolf (1946) found no evidence to suggest that infants were capable of differentiating between facial expressions on the experimenter's face or on a mask. Spitz

and Wolf examined the reactions of 145 infants between 2-6 months to several facial expressions. The classic threat expression, as well as the other expressions elicited only smiles--a reaction comparable to the 3-month olds in Bühler and Hetzer's research. Had Spitz and Wolf included slightly older children in their study they may have noted a developmental trend. It is not possible to determine from their study whether the experimenter's facial expressions actually moved or were stationary as was the case with the mask. Hence no interpretation of their findings is possible in terms of effects of movement upon recognition.

Ahrens' (1954) findings are consistent with the results reported by Bühler and Hetzer (1928) even though still, schematized, rather than live faces were used as stimuli. Working with institutionalized children, Ahrens found that at 5 months, infants can discriminate between drawings of negative (crying), positive (laughing) or neutral expressions. At 8 months, infants reacted to a drawing of a frowning face (eyebrows wrinkled more or less vertically) with distress and avoidance behavior. Thus Ahren's findings would suggest that by the second half of the first year, infants are capable of differentiating various facial expressions, and were not merely reacting to movement or some particular aspect of the face (e.g., the presence of two eyes).

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In a more recent study, Wilcox & Clayton (1968) used visual fixations to determine whether 5-month old infants could discriminate between smiling, frowning and neutral expressions presented both as moving and non-moving pictures. Apart from one exception, no significant difference was found in average fixations times to the different expressions. Lack of any

demonstrable preference, of course, does not necessarily indicate an inability to differentiate between the various expressions; it is possible that the infant may quite readily detect differences between facial expressions, without preferring one expression.

Infants' reactions to expressions of other infants

Although research in the area of early peer interactions is sparse, naturalistic observations of institutionalized infants made over forty years ago provide descriptions of early interactions which are relevant to the question of the infant's development of sensitivity to others' expressive behaviors.

Bühler (1930) noted that as early as 2 months, infants react to the cries of other infants. She reports that upon hearing a crying infant, a 2-month old infant will 'cry lustily'. Bridges (1933), in contrast, reports that although movements in an adjacent crib will attract the attention of a 2-month old infant, the crying and the vocalizations of another infant would go unheeded. According to her, it is not until 4-5 months that an infant becomes attentive to the cries of another child; at 4-7 months, Bridges observed that it was not uncommon for the cries of one infant to elicit cries from other infants in the same ward. She attributes this reaction to temporal conditioning--that is, as meal-time approaches, the infant becomes increasingly hungry, and cries. At 7-8 months, usually in response to another infant's movements, cooing or happy vocalizations, an infant will smile and approach the other infant. By 10 months, infants will cry, laugh or vocalize in imitation of another infant. And by the time he is 12 months, an infant attempts to elicit another

infant's laughter. (Bridges, 1932, 1933) Thus, by the time he is one year old, the child is sensitive to the laughter, cries, and happy vocalizations of other children.

Little is known of the development of the toddler's and pre-toddler's sensitivity to facial expressions and gestures. Most studies have been laboratory studies which have focused primarily on the child's ability to label pictures of various expressions (v. Charlesworth & Kreutzer, 1973). The non-laboratory, ethologically-oriented studies have tended to examine in detail the child's expressions and the situations in which they occur--to the neglect of the child's reactions to these signals. (Blurton-Jones, 1972)

Purpose of present study

As the review of the research indicates, testing situations of infant reactions to various expressions of emotions (with the exception of Bühler's work) have employed either masks, photos, or stationary poses of stylized expressions, instead of more naturalistic displays of emotions involving live models. That real faces are responded to by infants more readily and vigorously than photographed faces has been demonstrated by Polak et al. (1964), thus underlining the importance of using naturalistic displays when studying infants' social perception.

The purpose of the present study was to extend, and improve upon, Bühler's work by examining the development of the infant's sensitivity to several expressions of emotion, using naturalistic stimuli (i.e., the face and voice of an immediately present experimenter) under controlled conditions. The decision to use natural rather than artificial stimuli was

prompted by concerns for the relevance of the obtained findings for questions concerning the development of the infant's sensitivity to expressions under natural life conditions. By recording the infant's behavior on video tape and using a standardized method for rating behavior, it was possible to obtain more objective measures of the infant's recognition behaviors than has heretofore been the case.

Method

Subjects

Subjects were 40 single-born, physically normal infants, ranging from 17 to 46 weeks of age. Five males and five females were included in each of four age levels tested: 4, 6, 8, and 10 months. The infants were obtained both from the Child Care Clinic at the University of Minnesota Hospital, Minneapolis, Minnesota and through newspaper listings of local birth announcements. A total of 52 infants originally participated in this study. However, 8 infants were excluded because they became irritable and failed to respond to the mother's attempts at comforting. Data from an additional 4 infants were not usable because of equipment difficulties.

Experimental setting

S was seated in a high chair with a tray. A closed-circuit TV camera was located behind a felt screen 3 feet in front of S's face. The parent was seated 3 to 4 feet to S's left. The chair from which E presented her face as a stimulus was located 2 to 3 feet in front of the highchair, facing S at a 45 degree angle. A signal panel indicating when the stimulus was presented to S was located immediately behind S and controlled by an observer. A closed-circuit TV camera, located behind a felt screen 3

feet in front of S, filmed both S's face and the signal panel. The video-tape recorder, video-monitor and polygraph were located in an adjacent room.

Procedure

Before the experimental session, S and his parent were familiarized with the research room, E, and the observer. Sitting in his parent's lap, S was allowed to manipulate several toys serving as stimuli in another experiment which preceded the present one. Once S appeared familiar with the situation, electrodes were placed on his chest and his heart rate was recorded on a polygraph during the whole session. The parent then placed S in the high chair and the experimental session began. For younger S's padding or an infant seat was added to the high chair for support. Several four-month-olds were placed in their parent's lap because they were unaccustomed to an infant-seat.

In each session, S's engaged in several experiments--an object permanence task and a number of items designed to elicit laughter followed by the presentation of various expressions of emotions in the present experiment. The present experiment followed the object concept session on the average of no more than 5 minutes. Fewer than 8 minutes were required for the presentation of facial expressions.

In the present experiment a female E made four standard facial expressions--neutral (N), angry (A), sad (S), and happy (H)--each expression being presented twice to each S, in two blocks of 4 different expressions. The neutral expression was presented first in the two blocks, i.e., on the 1st and 5th trials. Angry, sad, and happy expressions were presented

randomly across S's in each of the two blocks, i.e., on Trials 2, 3, 4, and Trials 6, 7, 8.

The facial expressions were presented for approximately 15 seconds and accompanied by standard and appropriate verbalizations (v. below). During an inter-expression interval of approximately 35 seconds, (as well as a brief period preceding Trial 1 and following Trial 8) E's face was obscured by a cardboard screen held in front of E's face. At the beginning of, or during the experimental session, S's were given a small toy (previously used in the object concept experiment) to help make them less restless. If a baby became irritable during the presentation of the 8 expressions, the sequence was interrupted while the parent calmed the infant; then, if appropriate, the sequence of stimuli was continued.

Descriptions of the facial expressions

The neutral, angry, sad and happy expressions presented to S can be described briefly by using a modified version of the categories of facial expression delineated by Brannigan and Humphries (1972).

Neutral expression

Mouth: Lips were relaxed and expressionless, comparable to what Brannigan and Humphries (1972) refer to as the 'basic mouth position'.

Eyebrows: Eyebrows were in the usual resting position.

Gaze direction: E's gaze was directed at the infant's face.

The neutral expression was accompanied by a monotonic voice, devoid of affect. The verbalizations for the duration of the trial were: "Hi (infant's name).. You're a nice baby. A very nice baby. You're being awfully good today. You're such a nice baby."

Angry expression

Mouth: Lips were tense and pressed together, but not pursed or puckered. That is, the distance between the corners of the mouth was not appreciably less than the distance during normal rest. This is comparable to what Brannigan and Humphries (1972) refer to as 'tight lips'.

Eyebrows: Eyebrows were in an 'angry frown'--with the eyebrows lowered mainly in the midline towards the nose, tending to decrease the space between the two brows, and to create slight vertical furrows between the brows.

Eyelids and eye surroundings: Eyelids were open, with some tension in the eye region, reflected by slight decrease in the visible area of the white of the eye, as a consequence of the decrease in the space between the upper and lower eyelids.

Gaze direction: E's gaze was directed at the infant's face. The angry expression was accompanied by a stern and raised voice. The verbalizations for the duration of the trial were: "(infant's name), why did you do that? That's bad. Really, (infant's name), that's a very naughty thing to do. That's very naughty."

Sad expression

Mouth: The corners of the mouth were drawn down, and the lower lip was protruded. The lips were trembling slightly.

Eyebrows: The eyebrows were in what Brannigan and Humphries label the 'sad frown'--that is, the inner ends of the eyebrows were slightly lifted, and the outer ends are lowered, creating slight vertical folds between the eyebrows.

Gaze direction: E's gaze was directed at the face of the infant. The sad expression was accompanied by high-pitched vocalizations and sobbing. The verbalizations for the duration of the trial were: "Oh, (infant's name), I'm so sad. You've made me very unhappy. Why did you do that? I'm so sad!"

Happy expression

Mouth: The mouth corners were drawn up and out, the lips are parted to reveal some of the upper teeth. The lower teeth were revealed sporadically, as a result of the accompanying verbalizations.

Eyebrows: The eyebrows were in a usual resting position.

Gaze direction: E's gaze was directed at the infant's face.

Head movement: E's head was tilted slightly to the side.

The happy expression was accompanied by high-pitched sing-song vocalizations for the duration of the trial: "Hi (infant's name). You're a nice baby. You're such a good baby! My, what are you wearing today? What a nice shirt!"

Rating of behavior

In order to preclude the raters' knowledge of E's expressions presented S on any single trial, as well as the identification of the subject's age and sex, a rating sheet was prepared containing only the first initial and the last name of each subject, and his tape location (the number of the tape, and the initial and final frame numbers for each trial). Nothing in the video tape itself provided information on these variables with the exception, of course, of the physical appearance of the infants.

Raters scored the video-tapes for attention, positive and negative affect, and activity. The behavioral ratings and their definitions for each scale follow.

Attention Scale

A: Attends to E.

Amt: Attends most of the time; looks away from E only briefly.

Abr: Attends only briefly to E; most of the time does not attend.

Abf: Attends back and forth (defined by S looking at E, elsewhere, back at E, and so on).

AE: Attends elsewhere.

AO: Attends to the object (a toy which S is holding).

Affect Scale

\+ Positive: S smiles or laughs.

0 Neutral: a usual, relaxed base-level of affect. This category includes random grimaces or fleeting facial movements which did not appear related to the ongoing stimulus or accompanied by any affect.

\- Negative: S is serious and intent; or S frowns, almost cries, or cries.

Activity Scale

0 Inactive; S is totally still, or almost totally still, with the exception of a few weak, sporadic, localized movements.

1 Fairly still; slow continuous localized movements, or very slow body movements.

2 Moderately active; usual activity.

3 Very active; intense rapid movements of limbs.

Behavioral ratings of attention, affect, and activity were made for each of three 5-second phases of each trial. Raters were made aware of the 5-second intervals by a timer which emitted a click every 5 seconds.

There was no restriction on the number of ratings which could be made during a 5-second phase to describe the infant's activity, affect, or attention--for example, it was possible to rate the activity of a given subject as: $0/3/1_{Br}$--indicating that within a 5-second phase, the subject was inactive then made some rapid, energetic movements, followed by a brief period in which he was fairly still.

In addition to these ratings, the raters used write-ins to supplement the fixed rating scale. These write-ins included approach behavior, avoidance behavior, coyness, frowning, serious attentiveness, and incipient crying.

Independent inter-rater reliabilities in percentage of agreement (total number of agreements divided by highest number of ratings made by any one rater) ranged from 84% to 100% ($\bar{X}$ = 95%) for Attention, from 69% to 93% ($\bar{X}$ = 80%) for Affect, and from 74% to 92% ($\bar{X}$ = 84%) for Activity. The mean for all independent inter-rater agreement was 80%. These are relatively high agreements considering that each scale had from 3 to 6 categories and that multiple ratings on a single scale were frequently made for very short intervals of time.

Dependent inter-rater agreement (agreement established after each rater independently rated and then discussed his rating with the other rater) ranged from 92% to 100% ($\bar{X}$ = 97%) for Attention, 73% to 90% ($\bar{X}$ = 84%) for Affect, and 94% to 95% ($\bar{X}$ = 95%) for Activity. The mean for all dependent inter-rater agreement was 91%.

Ratings agreed to by both raters (i.e., the dependent inter-rater agreement) were used for final data; the senior author made the final

decision in those ratings for which there was disagreement.

Preparation of data for statistical analyses

For each phase of each trial, ratings on Affect, Attention, and Activity were converted to numerical values.

For affect, S received both a Positive and a Negative Affect score. The numerical conversions reflected duration of a positive and negative rating for each phase. To illustrate, if only one judgment was made during phase 1 (e.g., a "+"), then S's score for positive affect in Phase 1 would be 1. If 2 or 3 ratings of affect were made per phase, and only 1 rating was positive, then S's Positive Affect Score would be .50 or .33 respectively (since the duration of this positive behavior is estimated to be one-half or one-third of the 5-second phase). Any rating with a subscript of Br (brief duration) was arbitrarily assigned a weight of .20; if this occurred in conjunction with other ratings for the same phase, then the weights of these other ratings were derived from .80, instead of from 1.0 as in the preceding examples. Thus, a rating of "+/0/-" would be assigned a Positive Affect Score of .33; but a rating of "+/0/$-_{Br}$" would be assigned a Positive Affect Score of .40.

Scores for activity and attention were derived by weighting for intensity as well as for duration. Once weights were assigned for duration (following the procedure outlined above for Affect), specific weights were assigned for intensity. Attending to E was assigned a weighting of 1; whereas attending to the object and not attending were assigned weights of 0. Attending back and forth was given a weighting of .50. Attending only briefly was assigned a weight of .20; not attending briefly was assigned a

weight of .80. To illustrate the weighting procedure for the Attention Scale, the rating: "Attends to the object/Not attending briefly/Attending" would result in an Attention Score of .594, ((.33) (0) + (.33) (.80) + (.33)(1)), indicating that this subject was attending to the experimenter for approximately 60% of the 5-second phase.

For activity, ratings were weighted for duration, using the procedures outlined for affect, then for intensity, with weights (1, 2, and 3) corresponding to the activity category (1, 2, and 3). To illustrate, the rating: 0/2/3 would give an Activity Score of 1.65 for that phase. (i.e., (.33) (0) + (.33) (2) + (.33) (3))

For several subjects, a full 15-second record of their reactions to each expression was not obtained. In 3 cases, S leaned over the edge of the highchair or turned his head, thus his face was not on film. These empty cells were replaced by neutral affect ratings, and therefore, do not affect the accuracy of the Positive or Negative Affect Scores. In a few other cases, the final few seconds of the third phase were missing, or the entire third phase (5 seconds) was missing, as a result of a restless child, or human error. If only 2-3 seconds were missing, then it was assumed that the unrecorded behavior would not differ appreciably from the immediately prior 2-3 seconds of behavior which were recorded. If the entire third phase was missing, however, the empty cells were replaced by least-biased ratings: neutral affect; attending back and forth (that is, attending to E for approximately 50% of the time); and an activity rating of 1 (the most frequently employed category of the Activity Scale).

Results

Analyses of variance were carried out on each of four dependent measures (Attention, Positive Affect, Negative Affect, and Activity) for the first four trials.[1] (Only the data from the video-tape records, not the polygraph heart-rate records, are reported here.) Between-subjects factors were Age and Sex; within-subjects factors were Condition (Neutral, Angry, Sad and Happy) and Phase (I (0 to 5 seconds), II (5-10 seconds), III (10-15 seconds)). The means and F values for all four dependent measures are given in Tables 1 and 2.

Attention

The analysis revealed significant main effects for Condition, $F(3,96) = 7.67$, $p < .0005$. The Sad condition elicited significantly more attention than the Neutral, Angry, or Happy conditions. As expected, there was a decline in attention from the first to third phases, across all subjects and conditions, $F(2,64) = 41.10$, $p < .0005$. There was also a significant Sex x Condition interaction, $F(3,96) = 3.29$, $p < .025$, which indicated that males were more attentive than females during the Angry condition. For the males, then, there were two very salient stimuli: the Angry and Sad conditions; for the females, the Attention Scores indicate that only the Sad condition was an especially salient stimulus.

Positive Affect

No significant main effects for Age or Condition were obtained for positive affect. However, the analysis of the Positive Affect Scores gave a significant main effect for Phase, $F(2,64) = 12.91$, $p < .0005$. The amount of positive affect declined monotonically from Phase I to Phase III, as indicated in Table 1.

Several interactions were also significant. There was an Age x Phase interaction, $F(6,64) = 2.51$, $p < .05$; which indicated that the decline in positive affect over phases was especially pronounced in the four-month group. The analysis of Positive Affect Scores also gave significant effects for Age x Sex x Condition interaction, $F(9,96) = 2.08$, $p < .05$, and Age x Sex x Condition x Phase interaction, $F(18,192) = 1.74$, $p < .05$. Whereas the eight- and ten-month groups displayed less positive affect during the Angry and Sad conditions relative to the other two conditions, the positive affect of the four- and six-month groups was more evenly distributed--with the exception of the four-month males, whose positive affect was concentrated during the Angry condition. No attempt will be made to interpret the Age x Sex x Condition x Phase interaction.

Negative Affect

The significant Age effect, $F(3,32) = 9.67$, $p < .0005$, indicated that the amount of negative affect, summing across all conditions, increased with age. There was a strong monotonic increase, in total negative affect (i.e., across all conditions and phases) from the four-month group, to the ten-month group. The differential effectiveness of the various conditions in eliciting negative affect was also significant, $F(3,96) = 17.41$, $p < .0005$. The Angry and Sad conditions elicited more negative affect than the Neutral and Happy conditions. There was also a significant Age x Condition interaction, $F(9,96) = 2.27$, $p < .025$. Older subjects show more negative affect than the four-month subjects in general, and, as illustrated in Table 1, this negative affect was elicited mostly by the Angry and Sad conditions. Thus, it appears that, by six months, infants begin discriminating between

negative and positive expressive behaviors in others. If we assume that Angry and Sad expressions are more prone to elicit negative affect than Neutral and Happy expressions, then these infants responded appropriately; they clearly responded negatively to the Angry and Sad emotions.

Activity

The analysis of the Activity scores gave a significant main effect only for Phase, $F(2,64) = 7.49$, $p < .005$. As indicated in Table 1, there was a monotonic increase in activity from the first phase to the third phase. There were several interesting trends which approached significance. First, there was a Condition effect, $F(3,96) = 2.38$, $p \approx .08$; there was less activity during the Sad and Angry conditions, relative to the Neutral and Happy conditions. Second, there was a Condition x Phase interaction, $F(6,192) = 1.84$, $p < .10$. During the first phase, the amount of activity did not vary significantly across the four conditions (means ranged from 21.20 to 22.52). By the second phase, however, there tended to be more activity during the Neutral and Happy conditions, relative to the Angry and Sad conditions. For the Neutral, Angry, and Happy conditions, the amount of activity increased from Phase I through Phase III, although the rate of increase was greater for the Neutral and Happy conditions. For the Sad condition, the amount of activity first increased, then in Phase III decreased to below its initial level in Phase I. Third, there was a Sex x Phase interaction, $F(2,64) = 2.41$, $p < .08$. For males, the amount of activity increased across the three phases, whereas for females, the amount of activity first increased, then decreased. Thus, although both sexes showed a comparable amount of activity during Phase I, the males were considerably more active than the females by Phase III.

Discussion

The results of the present study indicate that 4-month old infants, when viewed in terms of their attention, activity, and affect behavior, respond indiscriminately to happy, angry, sad and neutral expressions. While the infant at this age quite obviously responds to the element of social approach (in the sense that he demonstrates awareness of the immediate presence of a person), he does not respond to the particular emotional tone of this approach.

By 6 months, however, the infant is capable of discriminating between positive and negative expressive behaviors in others. He reacts significantly more negatively (i.e., frowns, cries, almost cries, or appears serious and intent) to sad and angry expressions than to happy and neutral expressions. Also at this age, the infant is significantly more attentive to sad expressions than angry, happy, or neutral expressions. However, he does not discriminate between emotional expressions with positive affect (i.e., by smiling or laughing) nor with activity on his part.

Eight and 10-month infants respond in the same way as 6-month olds to sad and angry expressions. However, their behavior tends (although not significantly) to be slightly more elaborate than that of younger infants. They tend to show more positive affect to neutral and happy expressions and less to angry and sad. In addition, the 10 month old tends to become still or less active during displays of anger and sadness.

In general, activity and positive affect behavior provide less adequate measures of infant's sensitivity to expressions of emotions than do negative affect behavior and attention.

The absence of any overall sex differences in the present study is somewhat surprising, in view of several lines of evidence which suggest that females are more socially oriented than males (v. Maccoby, 1966).

The results of this study corroborate and extend the observations made by Darwin (1877) and Bühler and Hetzer (1928). Darwin reported that his 5-month-old son showed sensitivity to expressions of sadness. Bühler and Hetzer (1928), on the basis of an examination of infants' reactions to friendly and threatening facial expressions, voices and gestures, concluded that between the fifth and eighth month, infants are capable not only of differentiating between positive and negative expressions, but also of responding appropriately. The present study which included additional expressions, found support for the conclusions made by Bühler and Hetzer.

It is interesting to note that Bühler and Hetzer also reported that 8 to 12 month-old infants reacted to the angry expression with initial hesitation, followed by laughter and other behaviors, treating the scolding expression as a game. In the present study, there was no comparable decrease in the proportion of older infants who discriminated between the positive and negative expressions and acted appropriately. Contrary to the findings of Bühler and Hetzer, the 8 and 10 month infants in the present study showed no significant decrease in negative affect over the three phases of the angry and sad expressions; nor did they show any increase in the amount of positive affect.

The picture that emerges from these findings, considered along with other research cited above, is that the young infant makes progressively finer social discriminations with age. During the first few weeks of life,

the infant is not at all selective; he smiles at social stimuli and many other non-social stimuli as well. At this age, a smile can be elicited by any stimulus with 2 small dark dots on a lighter colored surface. The infant later differentiates human voices and faces from other stimuli, yet smiles indiscriminately at these social stimuli, whether threatening or friendly. By the fourth week, the infant smiles more to the sound of familiar voices than unfamiliar voices. A comparable differentiation between familiar-unfamiliar faces is not evident until much later, usually when the infant is approximately 3 1/2 months. By the sixth month, the infant differentiates sad and angry expressions from happy and neutral expressions, reacting with significantly more negative affect to displays of anger and sadness. Had the infant been reacting to displays made by a more familiar person, or in settings which were more familiar, as well as appropriate for each expression, it is possible that these social differentiations may have been evident even earlier.

This evidence for early sensitivity to displays of emotion is not surprising if considered in context of the comparative literature. Birds, for example, are sensitive very early to warning calls which signal the presence of a predator. It has even been demonstrated that chicks, while still in the egg become still and silent upon hearing the warning call of other chickens (Baeumer, 1955). In non-human primates there is also considerable evidence of infant response to the mother's emotional state. DeVore (1963), for example, notes that the year-old infant baboon shows behavioral evidence of being very sensitive to the mother's emotional states, even when away from her side.

In most cases of lower animals it appears that the sensitivity of the young to adult expressive behavior has obvious survival value. The function of the human infant's developing ability to recognize adult emotions is not known for certain. One could argue that most parents would give the infant adequate care and protection whether the infant were aware of his emotional state or not. However, it also seems reasonable to assume that the development of an increasingly more effective and satisfying relationship between parent and infant becomes possible when the latter demonstrates increasing awareness of the parent's behavior, moods, and intentions. Expressing mild fear or a sense of seriousness when being admonished, or joy and happiness when the parent is in a playful mood, most probably rewards parents and thereby strengthens their bond to the infant.

Although the present study indicates that by 6 months, infants are capable of making discriminations between expressions of positive and negative emotions, the distinctive features of the emotional expressions which make recognition possible at this age were not determined. The inclusion of the neutral expression makes it possible to conclude that the infants were not responding merely to the presence or absence of a smile, since the infants' responses to neutral and happy expressions were remarkably similar. Other than this, it is not possible to determine whether the infants' discriminations were based on the volume or pitch of the voice, some other single aspect of the stimulus or any combination of visual and auditory elements.

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Footnote

1. Computations were carried out on the IBM 360 at the University of Minnesota Campus Computer Center, using the BMD 08V program.

Table 1

Mean Behavior Scores by Condition, Phase, and Age

Behaviors and Ages	Condition	Neutral				Angry				Sad				Happy			
		Phase I	II	III	Combined	Phase I	II	III	Combined	Phase I	II	III	Combined	Phase I	II	III	Combined
Attention																	
4 months		.79	.57	.36	1.72	.72	.83	.53	2.08	.70	.71	.36	1.77	.77	.62	.31	1.70
6 months		.63	.47	.42	1.52	.64	.52	.28	1.44	.76	.74	.67	2.17	.64	.41	.40	1.45
8 months		.57	.38	.28	1.23	.70	.29	.34	1.33	.68	.78	.48	1.94	.64	.45	.32	1.41
10 months		.61	.30	.32	1.23	.62	.61	.46	1.69	.88	.84	.62	2.34	.66	.44	.44	1.54
$\bar{X}$ =		.65	.43	.34	1.42	.67	.56	.40	1.63	.76	.76	.53	2.05	.68	.48	.36	1.52
Positive Affect																	
4 months		.32	.12	.07	.51	.35	.32	.10	.77	.30	.16	.02	.48	.32	.28	.04	.64
6 months		.07	.10	.05	.22	.10	.10	.10	.30	.10	.14	.05	.29	.18	.10	.02	.30
8 months		.20	.20	.03	.43	.17	.07	.08	.32	.13	.04	.05	.22	.23	.17	.14	.54
10 months		.19	.18	.08	.45	.00	.05	.00	.05	.05	.15	.06	.26	.17	.22	.10	.49
$\bar{X}$ =		.20	.14	.06	.40	.16	.14	.07	.37	.14	.12	.04	.30	.22	.19	.08	.49
Negative Affect																	
4 months		.00	.00	.00	.00	.00	.00	.00	.00	.05	.13	.20	.38	.00	.00	.00	.00
6 months		.00	.00	.05	.05	.40	.35	.35	1.10	.15	.18	.20	.53	.08	.00	.00	.08
8 months		.00	.00	.02	.02	.48	.20	.15	.83	.35	.53	.47	1.35	.00	.00	.05	.05
10 months		.04	.15	.20	.39	.50	.65	.50	1.65	.65	.60	.55	1.80	.05	.10	.15	.30
$\bar{X}$ =		.01	.04	.06	.11	.34	.30	.25	.89	.30	.36	.36	1.02	.03	.02	.05	.10
Activity																	
4 months		.40	.73	.80	1.93	.45	.52	.65	1.62	.60	.80	.45	1.85	.48	.60	.63	1.71
6 months		.45	.45	.74	1.65	.55	.60	.82	1.97	.35	.60	.50	1.45	.54	.90	.74	2.18
8 months		.60	.97	1.26	2.83	.75	.80	.65	2.20	1.00	.75	.72	2.47	.60	.82	1.01	2.43
10 months		.80	1.00	1.05	2.85	.43	.70	.65	1.78	.24	.50	.52	1.26	.49	.80	.86	2.15
$\bar{X}$ =		.56	.78	.96	2.30	.54	.66	.69	1.89	.54	.66	.54	1.74	.53	.78	.81	2.12

Table 2

p values* of F scores Obtained by Analyses of Variance

for Different Behaviors According to Age, Condition, Phase and Sex

	Behavior			
Effect	Attention	Positive Affect	Negative Affect	Activity
Age	...	...	.0005	...
Condition	.0005	...	.0005	≈.08
Phase	.0005	.0005	...	.0005
Age X Condition	...	...	.025	...
Age X Phase	...	.05	...	...
Sex X Condition	.025	...	...	...
Sex X Phase	...	...	...	.08
Condition X Phase	...	...	...	.10
Age X Sex X Condition	...	.05	...	...
Age X Sex X Condition X Phase	...	.05	...	...

* Only p values of .10 or less included.